ABSTRACT

A method for processing a received, modulated pulse (*i.e.* waveform) that requires predictive deconvolution to resolve a scatterer from noise and other scatterers includes receiving a return signal; obtaining $L+(2M-1)(N-1)$ samples y of the return signal, where $y(\ell)=\tilde{\mathbf{x}}^T(\ell)\,\mathbf{s}+v(\ell)$; applying RMMSE estimation to each successive N samples to obtain initial impulse response estimates $[\hat{x}_1\{-(M-1)(N-1)\},\cdots,\hat{x}_1\{-1\},\hat{x}_1\{0\},\cdots,\hat{x}_1\{L-1\},\hat{x}_1\{L\},\cdots,\hat{x}_1\{L-1+(M-1)(N-1)\}]$; computing power estimates $\hat{\rho}_1(\ell)=|\hat{x}_1(\ell)|^2$ for $\ell=-(M-1)(N-1),\cdots,L-1+(M-1)(N-1)$; computing MMSE filters according to $\mathbf{w}(\ell)=\rho(\ell)\,(\mathbf{C}(\ell)+\mathbf{R})^{-1}\mathbf{s}$, where $\rho(\ell)=|x(\ell)|^2$ is the power of $x(\ell)$, and $\mathbf{R}=E[\mathbf{v}(\ell)\,\mathbf{v}^H(\ell)]$ is the noise covariance matrix; applying the MMSE filters to y to obtain $[\hat{x}_2\{-(M-2)(N-1)\},\cdots,\hat{x}_2\{-1\},\hat{x}_2\{0\},\cdots,\hat{x}_2\{L-1\},\hat{x}_2\{L\},\cdots,\hat{x}_2\{L-1+(M-2)(N-1)\}]$; and repeating (d)-(f) for subsequent reiterative stages until a desired length-L range window is reached, thereby resolving the scatterer from noise and other scatterers. The RMMSE predictive deconvolution approach provides high-fidelity impulse response estimation. The RMMSE estimator can reiteratively estimate the MMSE filter for each specific impulse response coefficient by mitigating the interference from neighboring coefficients that is a result of the temporal (*i.e.* spatial) extent of the transmitted waveform. The result is a robust estimator that adaptively eliminates the spatial ambiguities that occur when a fixed receiver filter is used.